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OVERTHRUST FAULT IN NEARLY FLAT STRATA¹

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During the past summer the writer in the course of an examination of a part of the ceded lands of the Crow Indian Reservation, Montana, for the United States Geological Survey, discovered a small overthrust fault in nearly flat strata. The following brief description has been written, not only because of this peculiar occurrence of the fault, but because of the extraordinarily clear and almost diagrammatic condition of its outcrop, giving the photograph a possible value for the purposes of textbook or other illustration.

The fault is located in the N.E. $\frac{1}{4}$ S.W. $\frac{1}{4}$ sec. 3, T. 2 N., R. 35 E., P.M., Montana, a point about 10 miles east of the Bighorn River and about 15 miles south of its junction with the Yellowstone. The district is on the remote edge of the Bighorn uplift, the Bighorn Mountains lying about 70 miles away, somewhat to the west of south. About 15 miles southwest of the fault in T. 1 N., Rs. 33 and 34 E., the strata dip in a general northeasterly direction at angles ranging up to 35 degrees. This dip, however, decreases in a short distance, and within a radius of about 10 miles around the fault the rocks commonly lie at angles less than one degree, except for 500 feet immediately around it where the dips locally reach five or six degrees. About 20 miles to the north the strata dip uniformly from three to five degrees in a southerly direction so that the greater part of the area examined occupies the hollow of a broad, flat asymmetrical syncline, the fault being located nearer the southern and more steeply dipping limb. Faults are not uncommon in this area, but all of the other faults appear to be normal and none was observed within 4 miles of the small overthrust in question.

The general relations of the fault, which outcrops in the north bank of the coulee, are shown in Fig. 1. The heavy black stratum is a coal bed, the dislocation of which furnishes the key to the amount of displacement and the position of the fault zone. This

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zone may be seen in the photograph to extend to the left (westward) from near the position of the hammer. It dips 29 degrees east between the ends of the dislocated coal bed but flattens to the west.



FIG. 1.—Overthrust fault cutting coal bed, sec. 3, T. 2 N., R. 35 E., P.M. Montana.

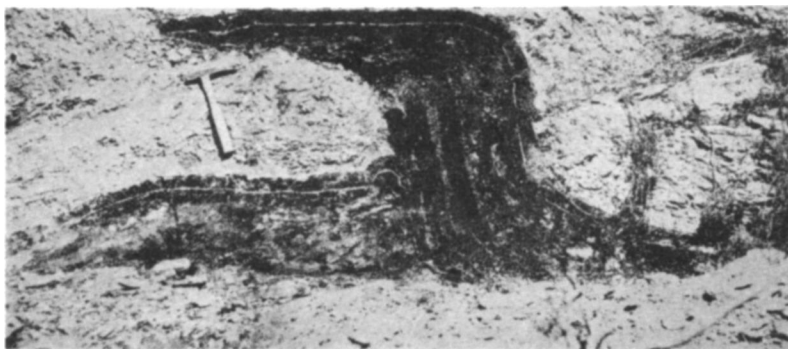


FIG. 2.—Nearer view of fault shown in Fig. 1

The peculiar shape in which the coal bed has been thrown also seems to indicate that the fault zone is not a plane but is curved near the place where it cuts the coal bed. The inclosing strata are

shale, with some sandstone, belonging to the Lance formation and overlain (see upper right-hand portion of Fig. 1) by alluvium. Fig. 2 is a nearer view of the coal bed, which is 16 inches thick, and contains a white clay parting which forms an excellent indicator of the exact character of the deformation. The total displacement is 29 inches.

The fault plane strikes north 15 degrees west. The nearest exposures along this line in either direction are about half a mile away and no trace of the fault can be found except at the locality described.

The thrust seems to have been from the northeast, i.e., toward the Bighorn Mountains. As stated above, it would seem that this fault is connected with the Bighorn uplift, but since there are very few, if any, thrust faults on the eastern slope of these mountains, and since comparatively little is known of the geology between the two localities, it is perhaps unwise to speculate on the tectonic relations of this small overthrust. A feature of greater interest is its occurrence in nearly flat strata, since overthrusting is commonly believed to be a characteristic of, and practically confined to, steeply dipping rocks. In most of the few published descriptions of apparent overthrust faults in flat-lying rocks the writers appear inclined to regard the dislocation as due in some cases to mere local squeezing, probably incident to the settling and adjustment of clay or other soft rock, or in other cases to the slight tilting of a normally faulted block.¹ In the present instance, however, the fault zone may be traced to the top of the cliff, a distance of about 35 feet across the strata, which include several thin sandstones. There seems little doubt as to its true overthrust character.

¹ The case noted by T. E. Savage in "The Geology of the Herrin Quadrangle," *Bull. Illinois State Survey*, No. 16, 1909, p. 279, may, however, be a true overthrust.